End of Result Set

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L4: Entry 4 of 4 File: USPT Sep 17, 1996

US-PAT-NO: 5557549
DOCUMENT-IDENTIFIER: US 5557549 A

TITLE: Knowledge based diagnostic advisory system and method for an air separation plant

DATE-ISSUED: September 17, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Chang; Ching M.	Williamsville	NY		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Praxair Technology, Inc.	Danbury	CT			02

APPL-NO: 08/ 411917 [PALM]
DATE FILED: March 28, 1995

PARENT-CASE:
This application is a Continuation of prior U.S. application Ser. No. 07/952,819 Filing Date Sep. 28, 1992.

INT-CL: [06] G06 F 17/00

US-CL-ISSUED: 364/551.01; 364/188, 364/402, 395/12, 395/50, 395/54, 395/161, 395/914

US-CL-CURRENT: 702/183; 345/841, 345/854, 345/965, 700/83, 706/11, 706/45, 706/914

FIELD-OF-SEARCH: 395/12, 395/50, 395/54, 395/157, 395/158, 395/160, 395/161, 395/911, 395/914, 395/915, 364/402, 364/188, 364/551.01

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected | Search ALL

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4591983	May 1986	Bennett et al.	364/403
☐	4752889	June 1988	Rappaport et al.	364/513
☐	4829426	May 1989	Burt	364/300
☐	4839822	June 1989	Dormond et al.	364/413.02
☐	4939680	July 1990	Yoshida	364/513
☐	4964063	October 1990	Esch	364/513
☐	4965741	October 1990	Winchell	364/513
☐	4972328	November 1990	Wu et al.	364/513
☐	5065347	November 1991	Pajak et al.	395/159
☐	5072412	December 1991	Henderson, Jr. et al.	395/159
☐	5099436	March 1992	McCown et al.	364/550
☐	5237654	August 1993	Shackelford et al.	395/160
☐	5241671	August 1993	Reed et al.	395/600
☐	5262761	November 1993	Scandura et al.	340/133
☐	5265031	November 1993	Malczewski	364/497
☐	5283864	February 1994	Knowlton	395/158
☐	5353316	October 1994	Scarola et al.	376/259

ART-UNIT: 241

PRIMARY-EXAMINER: Weinhardt; Robert A.

ASSISTANT-EXAMINER: Thomas; Joseph

ATTY-AGENT-FIRM: O'Brien; Cornelius F.

ABSTRACT:

This invention is a method and system for troubleshooting a breakdown or malfunction in an industrial plant facility identified by alarm or shutdown signals based upon forming a knowledge base of knowledge elements for providing advice and guidance to the technician. Each fault condition has a set of knowledge elements arranged in a sequence having an ordered hierarchy corresponding to different levels of information. The subordinate knowledge elements are linked to permit selection for display on a computer monitor in a specified manner and in a predetermined cascade arrangement relative to each higher level knowledge element to which it is linked.

10 Claims, 17 Drawing figures

Generate Collection Print

No

L4: Entry 2 of 4 File: USPT May 2, 2000

US-PAT-NO: 6056781
DOCUMENT-IDENTIFIER: US 6056781 A

TITLE: Model predictive controller

DATE-ISSUED: May 2, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wassick; John M.	Midland	MI		
McCroskey; Patrick S.	Midland	MI		
McDonough; John J.	Midland	MI		
Steckler; David K.	Midland	MI		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
The Dow Chemical Company	Midland	MI			02

APPL-NO: 09/ 020141 [PALM]
DATE FILED: February 6, 1998

PARENT-CASE:
This application is a continuation of prior application Ser. No. 07/959,629 filed on Oct. 13, 1992, now U.S. Pat. No. 5,740,033.

INT-CL: [07] G06 G 7/48, G06 G 7/58

US-CL-ISSUED: 703/12; 703/2, 703/6, 700/28, 700/29, 700/30, 700/31, 700/38
US-CL-CURRENT: 703/12; 700/28, 700/29, 700/30, 700/31, 700/38, 703/2, 703/6

FIELD-OF-SEARCH: 395/500.23, 395/500.27, 395/500.33, 364/149, 364/151, 364/153, 364/165, 703/2, 703/6, 703/12, 700/28, 700/29, 700/30, 700/31, 700/38

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4349869	September 1982	Prett et al.	364/159
☐	4358822	November 1982	Sanchez	364/151
☐	4368510	January 1983	Anderson	364/151
☐	4374703	February 1983	Lebeau et al.	162/253
☐	4663703	May 1987	Axelby et al.	364/149
☐	4791548	December 1988	Yoshikawa et al.	364/149
☐	4882526	November 1989	Iino et al.	318/561
☐	5000924	March 1991	Cygnarowicz et al.	422/109
☐	5024801	June 1991	Impink, Jr. et al.	376/217
☐	5038269	August 1991	Grimble et al.	364/148
☐	5043151	August 1991	Staffel et al.	423/305
☐	5060132	October 1991	Beller et al.	364/158
☐	5191521	March 1993	Brosilow	364/160
☐	5268835	December 1993	Miyagaki et al.	364/151
☐	5347446	September 1994	Iino et al.	700/29
☐	5402333	March 1995	Cardner	364/151

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ART-UNIT: 273

PRIMARY-EXAMINER: Teska; Kevin J.

ASSISTANT-EXAMINER: Sergent; Douglas W.

ATTY-AGENT-FIRM: Schultz; Dale H. Coughlin; William J.

ABSTRACT:

A model predictive controller for a process control system which includes a real-time executive sequencer and an interactive modeler. The interactive modeler includes both a process model and an independent disturbance model. The process model represents the dynamic behavior of the physical process, while the disturbance model represents current and future deviations from the process model. The interactive modeler estimates current process states from the process model and input data received from the executive sequencer. The executive sequencer then projects a set of future process parameter values, which are sought to be controlled, over a predetermined control horizon. The interactive modeler then solves a set of equations as to how the physical process will react to control changes in order to determine an optimized set of control changes. As a result, the process control system will be able to accurately track a predetermined set-point profile in the most effective and cost efficient manner.

12 Claims, 37 Drawing figures

L4: Entry 3 of 4 File: USPT Apr 14, 1998

US-PAT-NO: 5740033
DOCUMENT-IDENTIFIER: US 5740033 A

TITLE: Model predictive controller

DATE-ISSUED: April 14, 1998

INT-CL: [06] G05 B 13/04

US-CL-ISSUED: 364/149; 364/151, 364/153
US-CL-CURRENT: 700/29; 700/33

FIELD-OF-SEARCH: 364/149, 364/150, 364/151, 364/152, 364/153-165, 364/148

End of Result Set

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L5: Entry 1 of 1 File: TDBD Oct 1, 1994

TDB-ACC-NO: NN9410113

DISCLOSURE TITLE: Method for Estimating Equipment Reliability

PUBLICATION-DATA:
IBM Technical Disclosure Bulletin, October 1994, US

VOLUME NUMBER: 37
ISSUE NUMBER: 10
PAGE NUMBER: 113 - 118

PUBLICATION-DATE: October 1, 1994 (19941001)

CROSS REFERENCE: 0018-8689-37-10-113

DISCLOSURE TEXT:

This document contains drawings, formulas, and/or symbols that will not appear on line. Request hardcopy from ITIRC for complete article. Disclosed is a model and control process for estimating the reliability, or anticipating the performance, of a system or equipment. The model or process starts with the definition of a statistical data base for each component within a mechanical tool. A program then delineates a set of rules in a program to generate anticipated failure times of the tool based on statistical data. The statistical data and generated failure times, along with actual data collected from the mechanical tool, predict the reliability, anticipating the performance of the system, equipment, or tool.

This model and process, called RELI for Reliability Estimates of Equipment's Life Images, is used during the stages of developing a production tool to provide an estimate, concerning product flow, downtime, uptime, thruput, product loss, and efficiency. This method can be used to facilitate design improvements and to predict cost estimates, part replacements, planned maintenance, levels of parts inventories, etc. This method can also be used after a system is installed and operating to determine the RAS (Reliability, Availability, and Serviceability) efficiency of the machine, and to predict where efforts should be placed to create a better product and to increase thruput. Without this process, "stress tests" are used to provide answers to such questions. These tests are lengthy runs on each unit at different tolerance environments, such as accelerated speed, extreme temperatures, or deviations in levels of vibrations. While the results of such tests are used to make changes to the design of the system being built, the applications of these results to advance the design of other tools is minimal. Simulation and modeling can assist in answering most of these questions. However, the concept of simulation is to monitor the process flow of a machine over a short period, such as 24 hours, or for a period derived from a particular occurrence. While an assumption is made that this kind of simulation is done during the "good" life of the machine, data is not provided concerning the desired length of a burn-in process, the variations of individual units relative to the life distribution curves of each component, when to anticipate the beginning of a period in which the unit is wearing out, and the expected availability and performance of the system in six months, five years, and ten years. There are simulation systems that can perform life studies on mechanical tools, but while these systems are statistical and analytical, they are not oriented to process flow. Fig. 1 provides an overview of the RELI prediction package. At 1, a statistical data base is developed for each component within a mechanical tool, including parameters such as the MTTF (Mean Time To Failure, MTR (Mean Time for Repair), the shape or standard deviation of a failure distribution curve, etc. At 2,

a program generates failure times based on the statistical values given for each component or subassembly in the data base, using the statistical parameters known about the mechanical tool. At 3, a simulation of the mechanical tool executes for the entire life of the tool, interacting with a program to receive failure times. This simulation concept combines process and analytical definition to the life of the machine. At 4, a program interacts with the simulation to cause failure interrupts, collecting data about the tool during simulation. At 5, a graphical statistical system evaluates the results collected during the simulation. Fig. 2 shows a bathtub-shaped failure rate curve for the life of a mechanical system, which has been developed from statistical history. A burn-in period is followed by a good life period, which is in turn followed by a wear-out period. Fig. 3 shows the Weibull distribution used by the RELI program to generate failures. This function requires two parameters---a shape identified as m, and a characteristic identified as c. The parameter m controls the shape or slope of the curve, while the characteristic parameter c is the point at which 63.2 percent of the population has failed, indicating the mean failure time. If specific values for m are not found in the data base, the default values used for m = 0.5 to describe a decreasing failure rate shape creating the early life period, m = 1 to provide a constant failure rate during the good life period, and m = 3 to describe an increasing failure rate during the wear-out period. Expressions 1) and 2) are used to create the Weibull curve. Table 1 shows the relationship between m, c, and the mean of a Weibull function. Because the mean is the parameter defined in the data base, a gamma function is used to calculate the mean and variance of the distribution.

A data base is developed, describing the individual components of the machine being analyzed. The information in the data base provides statistical parameters which will replicate the failures, such as MTTF (Mean Time To Fail), MTR (Mean Time to Repair), and factors describing the lifetime distribution. Historical data pertaining to a group, such as bearings, springs, semiconductors, or robots, in which the individual component may be placed is also used. Since some groups do not follow the Weibull distribution, other distributions, such as normal or exponential distributions, may be used.

The FAILS analysis program processes data for each component in the data base, creating failure and repair times using the statistical parameters defined in the data base. This program continues creating failure times for each individual component until the accumulated total of these times is greater than or equal to the ending life of the system. Table 2 is an example of the output listing from the Failure File of a single component, generated using data provided by the FAILS analysis program. The SYSTEM interactive program relays failure times to an accelerated simulation of a machine, receiving statistical information from the simulation. The predicted failures from the FAILS analysis program provide downtime and repair time data for the simulation. In addition to simulating the machine in movement and product or process flow, code is incorporated to n to cause the machine to stop at the time of failure. Various routines interrupt and interact with the SYSTEM program to retrieve failure and repair times, and data is passed back to the SYSTEM program to record statistical information. The entire life of the machine is simulated, with accelerated process flow where possible. Table 3 is an example of the output listing from a data file established as simulation statistics are tallied and recorded during the operation of the SYSTEM program. The results of the SYSTEM program are also put into a graphical form for analysis and presentation.

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L5: Entry 1 of 1 File: TDBD Oct 1, 1994

TDB-ACC-NO: NN9410113

DISCLOSURE TITLE: Method for Estimating Equipment Reliability

PUBLICATION-DATA:
IBM Technical Disclosure Bulletin, October 1994, US

VOLUME NUMBER: 37
ISSUE NUMBER: 10
PAGE NUMBER: 113 - 118

PUBLICATION-DATE: October 1, 1994 (19941001)

CROSS REFERENCE: 0018-8689-37-10-113

DISCLOSURE TEXT:

This document contains drawings, formulas, and/or symbols that will not appear on line. Request hardcopy from ITIRC for complete article. Disclosed is a model and control process for estimating the reliability, or anticipating the performance, of a system or equipment. The model or process starts with the definition of a statistical data base for each component within a mechanical tool. A program then delineates a set of rules in a program to generate anticipated failure times of the tool based on statistical data. The statistical data and generated failure times, along with actual data collected from the mechanical tool, predict the reliability, anticipating the performance of the system, equipment, or tool.

Y

L7: Entry 2 of 3 File: DWPI Apr 6, 1994

DERWENT-ACC-NO: 1994-111045
DERWENT-WEEK: 199643

TITLE: Knowledge based diagnostic advisory method used in industrial plant facility - forming set of knowledge elements which are held on computer allowing technician to work through hierarchy of faults, advice and guidance to methodically locate and resolve source problem

INVENTOR: CHANG, C M

PATENT-ASSIGNEE: PRAXAIR TECHNOLOGY INC (PRAXN)

PRIORITY-DATA: 1992US-0952819 (September 28, 1992), 1995US-0411917 (March 28, 1995)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
EP 590571 A1	April 6, 1994	E	022	G05B023/02
US 5557549 A	September 17, 1996		024	G06F017/00
BR 9303913 A	May 24, 1994		000	G06F015/46
CA 2107051 A	March 29, 1994		000	G06F015/46
CN 1086028 A	April 27, 1994		000	G06F015/46

CITED-DOCUMENTS:EP 377736; EP 482523 ; US 5127005

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
EP 590571A1	September 27, 1993	1993EP-0115579	
US 5557549A	September 28, 1992	1992US-0952819	Cont of
US 5557549A	March 28, 1995	1995US-0411917	
BR 9303913A	September 27, 1993	1993BR-0003913	
CA 2107051A	September 27, 1993	1993CA-2107051	
CN 1086028A	September 27, 1993	1993CN-0118079	

INT-CL (IPC): G05B 23/02; G06F 15/46; G06F 17/00

ABSTRACTED-PUB-NO: EP 590571A
BASIC-ABSTRACT:

The method of trouble shooting a malfunction in an industrial plant involves using a knowledge base. This is held on a personal computer (20) and activated by the technician when a problem arises. The knowledge base consists of a hierarchy of knowledge elements providing advice and guidance for the technician.

The technician initially selects an entry related to the known malfunction and moves to the next level of information. This will indicate items to be checked or further knowledge to be accessed. Guidance is provided on the checking and rectification of areas found to have a problem.

USE/ADVANTAGE - For e.g chemical production facility. Improves problem solving time by providing an organised approach to problem and proposing solutions.

ABSTRACTED-PUB-NO: US 5557549A
EQUIVALENT-ABSTRACTS:

A diagnostic advisory system for troubleshooting an abnormal condition in the production of at least one gas in an air separation plant identified by one or more alarm or shutdown signals triggered by a different fault condition affecting the normal production of said at least one gas with said diagnostic advisory system comprising:

a programmed computer including memory means for storing a knowledge base of an air separation plant composed of a hierarchy of knowledge elements containing textual, graphical and/or video material for providing advice and guidance to an operator to enable the operator to monitor and to determine the cause of a fault condition of at least one gas and what action to take to correct such fault with the knowledge elements arranged in a sequence having an ordered priority corresponding to different levels of information with the highest priority knowledge element for the identified fault condition providing a preset number of diagnostic strategies with each strategy incorporating one or more subordinate knowledge elements in ranked order to the higher knowledge elements and to one another in accordance with the priority given to each level of information;

means for interactively linking subordinate knowledge element(s) to their higher priority knowledge element(s);

means responsive to a fault indicating signal for displaying each of said knowledge elements with each subordinate knowledge element displayed in a cascade formation relative to all higher ranking knowledge elements to which it is linked for said fault indicated signal; and

means for successively displaying one or more lower ranking knowledge elements within the linkage chain of knowledge elements to indicate what remedial action should be taken to correct the fault condition; and means for returning to any higher knowledge element from which the displayed lower knowledge element depends.

CHOSEN-DRAWING: Dwg.1/11 Dwg.1/11

DERWENT-CLASS: T01 T06
EPI-CODES: T01-J04A; T01-J07; T01-J16A; T06-A05A; T06-A08;

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L7: Entry 3 of 3 File: DWPI May 2, 1991

DERWENT-ACC-NO: 1991-126858
DERWENT-WEEK: 199631

TITLE: Manufacturing technician efficiency measurement method - measuring mfg. technician efficiency and providing feedback mfg. technician within computer based mfg. process plan

INVENTOR: FERRITER, K M

PATENT-ASSIGNEE: INT BUSINESS MACHINES CORP (IBMC), IBM CORP (IBMC)

PRIORITY-DATA: 1989US-0425640 (October 23, 1989)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
EP 425407 A	May 2, 1991		000	
DE 69027088 E	June 27, 1996		000	G07C003/10
US 5212635 A	May 18, 1993		008	G06F015/21
EP 425407 A3	April 15, 1992		000	
EP 425407 B1	May 22, 1996	E	011	G07C003/10

DESIGNATED-STATES: DE FR GB

CITED-DOCUMENTS:NoSR.Pub; 4.Jnl.Ref ; FR 2584214 ; GB 2034890 ; JP 57098066 ; JP 58163070 ; JP 59184958 ; JP 63267149 ; US 4583280 ; US 4847791

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
EP 425407A	August 29, 1990	1990EP-0480123	
DE 69027088E	August 29, 1990	1990DE-0627088	
DE 69027088E	August 29, 1990	1990EP-0480123	
DE 69027088E		EP 425407	Based on
US 5212635A	October 23, 1989	1989US-0425640	
EP 425407A3	August 29, 1990	1990EP-0480123	
EP 425407B1	August 29, 1990	1990EP-0480123	

INT-CL (IPC): G06F 15/21; G06F 15/46; G07C 1/10; G07C 3/10

ABSTRACTED-PUB-NO: EP 425407A
BASIC-ABSTRACT:

The method comprises the steps of storing a number of labour standard time values within a computer system for each of several operations within a manufacturing process, noting the initiation of a selected operation within a manufacturing process by a manufacturing technician and automatically displaying within the computer system an indication of the passage of the labour standard time for the selected operation by displaying a iconic graphical representation of the passage of the labour standard time. One graphic represents the amount of elasped time since the initiation of the selected operation and another represents the amount of time

remaining within the labour standard time. The graphic icon is in the shape of an hourglass.

The step of noting the initiation of a selected operation within a manufacturing process by a manufacturing technician comprises the step of prompting the technician to indicate the start of the selected operation.

ADVANTAGE - Provides improvement in mfg. technology which relates to methods and apparatus for measurement of technician efficiency.

ABSTRACTED-PUB-NO: EP 425407B
EQUIVALENT-ABSTRACTS:

A method in a computer system based manufacturing process for providing an indication of the efficiency of a manufacturing technician in the performance of a selected operation among a plurality of operations within a manufacturing process, said method comprising the steps of storing plurality of labour standard time values within said computer system which predict the amount of time required to complete each of said plurality of operations; displaying within said computer system a sequence of textual instructions (34, 36, 38, 40) for performing said plurality of operations; noting the selection of a particular one of said sequence of textual instructions by a manufacturing technician; determining a selected one of said plurality of operations which is initiated by performance of said particular one of said sequence of textual instructions; retrieving (76) a labour standard time value for said selected one of said plurality of operations; noting (78) an initiation of said selected one of said plurality of operations by said manufacturing technician; and automatically displaying (94) within said computer system a graphical representation of the amount of elapsed time since the initiation of said selected one of said plurality of operations, and a graphical representation of the amount of time remaining within said labour standard time for said selected one of said plurality of operations.

US 5212635A

The method is for measuring the efficiency of mfg. technician in the performance of selected operations within a computer based mfg. process. A mfg. process plan is stored within a computer system having a visual display. Those operations within the mfg. process plan having a known labour standard time value for each such operation is stored within the computer system.

Upon the initiation of an operation having a known labour standard time value a graphic representation, such as an hourglass, is automatically presented displaying the amount of elapsed time since initiation of the selected operation and the amount of time remaining within the labour standard time. The elapsed time value may be stored, upon the temporary suspension of the selected operation, and subsequently displaced upon the reactivation of the suspended operation.

ADVANTAGE - Provides improvement in mfg. technology which relates to methods and appts. for measurement of mfg. technician efficiency within computer based mfg. process plan.

CHOSEN-DRAWING: Dwg.2/3 Dwg.1/3 Dwg.2/3

DERWENT-CLASS: T01 T05
EPI-CODES: T01-J05A; T01-J07; T05-G02; T05-G03;